Beryllium isotopes from marine and lake sediments indicate melting of the West and East Antarctic Ice Sheet during the 4.2 Ka BP climate event

*Adam David Sproson[1,2], Yusuke Yokoyama[1,2], Yoshinori Takano[2], Rebecca Totten Minzoni[3], Bethany Behrens[1], Yosuke Miyairi[1], Takahiro AZE[1]

1. Atmosphere and Ocean Research Institute, The University of Tokyo, 2. Department of Biogeochemistry, Japanese Agency for Marine-Earth Science and Technology, 3. Department of Geological Sciences, The University of Alabama

The 4.2 ka BP climate event was a ca. 200 to 300 year period of synchronous abrupt megadrought, cold temperatures, and windiness that were manifest globally, coincident with societal collapses in the Northern Hemisphere, the most famous of which include the Egyptian Old Kingdom, Akkadian Empire and Harappan civilization [1]. Approximately 3 to 4 m of global sea-level equivalent melting occurred at the same time [2]. However, the melt water contribution from the Greenland and Antarctic ice sheets, and the response of the Southern Hemisphere, to the 4.2 ka BP event is not well understood. Here, we present the authigenic Be isotope composition of lake and marine sediments from the Lützow-Holm Bay (EAIS) and the Ferrero Bay (WAIS), respectively [3-5].

Meteoric ^{10}Be is produced in the atmosphere by cosmic rays and delivered to the Earth and ocean surface via dust and precipitation. In Antarctica, these sources of ^{10}Be become locked up in ice sheets and are subsequently released to the continental shelf during periods of melting and freshwater discharge, where they adhere to suspended particles in the water column and subsequently accumulate on the basin floor [6]. Stable ^{9}Be is present in silicate rocks and is released during subglacial weathering, with little simultaneous release of ^{10}Be, and transported to the oceans via meltwater outflow [7]. When Be is incorporated into the authigenic phase of marine sediments, the ^{10}Be/^{9}Be reflects that of the overlying water column [8], which in turn reflects the relative dominance of freshwater flux and/or subglacial weathering.

When ^{10}Be/^{9}Be ratios and ^{10}Be data from Lake Maruwan Oike, Lake Skallen and the Ferrero Bay are compiled with previous data from the Wilkes Subglacial Basin [9] and Ross Sea [10], they reveal a large increase in ^{10}Be abundance coincident with approximately 4 to 5 Ka BP, suggesting widespread meltwater discharge and destabilisation of parts of the WAIS and EAIS during this time. Such reorganisation of Antarctic ice sheets could be linked with a southern migration of the ITCZ, possibly caused by variations in ENSO. This would have caused a strengthening of the Southern Hemisphere westerlies which, in turn, would have caused enhanced upwelling of warm intermediate waters onto the shelf leading to increased marine ice shelf instability and melting [2, 9] suggesting possible Antarctic contribution to global sea-level rise.

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